Amendments to the Specification

Replace the paragraph beginning at page 3, line 11 with the following.

Preferably the narrowband interferer parameter estimates of each narrowband interferer are used to initialise a digital phase ~~locked~~ lock loop.

Replace the paragraph beginning at page 3, line 19, with the following.

Preferably the phase ~~locked~~ lock loops are updated with each incoming sample until either a counter expires or an OFDM packet is detected. The phase ~~locked~~ lock loops are used to estimate the carrier frequency of the narrowband interferers. Preferably the phase ~~locked~~ lock loops are digital phase ~~locked~~ lock loops. Preferably one phase ~~locked~~ lock loop is used for each interferer.

Replace the paragraph beginning at page 3, line 25, with the following.

Preferably the current narrowband interferer carrier frequency estimates from the phase ~~locked~~ lock loops that have achieved "lock" are used to initialise an excision filter when an OFDM packet is detected.

Replace the paragraph beginning at page 5, line 4, with the following.

Preferably the phase ~~locked~~ lock loops are arranged to estimate the carrier frequency of the narrowband interferers.

Replace the paragraph beginning at page 5, line 7, with the following.

Preferably one phase ~~locked~~ lock loop is used for each interferer.

Replace the paragraph beginning at page 5, line 9, with the following.

Preferably the current narrowband interferer carrier frequency estimates from the phase ~~locked~~ lock loops that have achieved "lock" are used by the filter estimator to initialise an

excision filter when an OFDM packet is detected.

Replace the paragraph beginning at page 5, line 18, with the following.

The invention will be further described by way of example only and without intending to be limiting with reference to the following drawings, wherein:

Figure 1A shows the bit error rate performance of BPSK modulated OFDM with a single interferer and signal to interference ratio (SIR) of -10 dB;

Figure 1B shows the bit error rate performance of BPSK modulated OFDM with a single interferer and SIR of 10 dB;

Figure 2A ~~shows an interference suppression detector of the invention~~ is a block diagram of an interference suppression detector as part of an OFDM receiver in accordance with the present invention;

Figure 2B is a flowchart showing one technique for interference suppression of the invention;

Figure 3 is a block diagram of an OFDM receiver including the interference suppression system of the invention;

Figure 4A shows a simulation of interferer carrier frequency estimation where the INR is 7.5 dB;

Figure 4B shows a simulation of interferer carrier frequency estimation where the INR is 6.6 dB;

Figure 4C shows phase lock loop indication for the interferers of Figures 4A and 4B;

Figure 5A shows a prototype excision filter frequency response;

Figure 5B shows an example of a two notch excision filter;

Figure 6A shows an example of a received signal with the narrowband interference suppression system in place;

Figure 6B shows the smoothed spectra of a first OFDM data block after narrowband interference is suppressed;

Figure 7A shows a received signal constellation including signal, narrowband interference and noise;

Figure 7B shows the received signal constellation after filtering to remove narrowband interference;

Figure 7C shows the received signal constellation when no narrowband interference is present;

Figure 8A is a simulation of bit error rates for BPSK modulated OFDM with two narrowband interferers and SIR of -10 dB;

Figure 8B is a simulation of bit error rates for BPSK modulated OFDM with two narrowband interferers and SIR of 0 dB;

Figure 8C is a simulation of bit error rates for BPSK modulated OFDM with two narrowband interferers and SIR of 10 dB;

Figure 9A is a simulation of bit error rates for BPSK modulated OFDM with two narrowband interferers and SNR of 6 dB;

Figure 9B is a simulation of bit error rates for BPSK modulated OFDM with two narrowband interferers and SNR of 12 dB;

Figure 9C is a simulation of bit error rates for BPSK modulated OFDM with two narrowband interferers and SNR of 18 dB;

Figure 10A is a simulation of bit error rates for 64-QAM modulated OFDM with two narrowband interferers and SIR of 0 dB; and

Figure 10B is a simulation of bit error rates for BPSK modulated OFDM with two narrowband interferers and SIR of -15 dB.

Replace the paragraph beginning at page 13, line 15, with the following.

Figure 2A is a block diagram of the interference suppression ~~technique of~~ detector as part of an OFDM receiver according to the invention and Figure 2B is a flow chart of the interference suppression technique of the invention. The narrowband interference suppression system can run in parallel with a technique for interference suppression during pilot symbol assisted detection and synchronisation such as that described in the applicant's patent application PCTINZ2004/000060 which is herein incorporated by reference. The multiple narrowband interference suppression system of the invention relies on estimating interference carrier frequency(s) during the signal-free period between data packets - this reduces the impact of the particular values of SIR and interferer carrier frequency on the algorithm performance. The estimated carrier frequencies are used to specify the excision filter applied to the received signal after detection. The multiple narrowband interference suppression system of the invention is particularly suited for interference suppression during the data transport phase of the data reception. However this technique can also be used during packet detection and synchronisation.

Replace the paragraph beginning at page 14, line 29 with the following.

In step 5 the equation is asked whether a packet has been detected. In the embodiment ~~packet~~ pilot detection is performed by another function (shown as step 12). If no packet has been

detected the 'no' arrow is followed from step 5 to step 10. If a packet has been detected the 'yes' arrow is followed from step 5 to step 6 and packet reception commences.

Replace the paragraph beginning at page 16, line 9, with the following.

Figure 2A is a block diagram of the ~~devices used in the~~ interference suppression ~~technique of~~ detector as part of an OFDM receiver according to the invention. The interference suppression apparatus of the invention is shown in blocks 33 and 34 and is positioned between front end 31 and a first stage of the OFDM receiver 35. The make-up of the front end 31 and the first stage of the OFDM receiver 35 are described in more detail in Figure 3. The narrowband interference detector includes an N bin FFT 36, a timer/counter 37, switches 38 and 39, digital phase lock loops 40 and 41, switches 42 and 43, filter design module 44, and excision filter 34.

Replace the paragraph beginning at page 17, line 10, with the following.

While the phase lock loops are operating a pilot symbol may be detected indicating the start of an OFDM packet. When a pilot symbol is detected by pilot symbol detector 32 switches 42 and 43 are operational to provide a lock indication and further estimates of the interferer frequencies to filter design module 44. The filter design module then designs a filter for the excision filter 34 based on the estimated interferer frequencies from the phase lock loops and also the lock indications. If a phase lock loop provides a "no lock" on the lock indication then the estimated interferer frequency from that phase lock loop will not be taken into account in the filter design. The excision filter is then designed as a notch filter to remove frequencies estimated as the interferer frequencies. Once the pilot symbol is detected samples proceed through the pilot detector ~~then through the excision pilot detector~~ 32 and then through excision filter 34 to the rest of the OFDM receiver 35.

Replace the paragraph beginning at page 17, line 23, with the following.

Figure 2A shows a block diagram of one embodiment of a narrowband interference suppression detector as part of an OFDM receiver ~~of~~ according to the invention. It is possible from the narrowband interference detector in different ways 25 including using a DFT instead of FFT operator 36 providing a different number of phase lock loops. The particular implementation given here should not be seen as limiting to those skilled in the art.

Replace the paragraph beginning at page 17, line 31, with the following.

Figure 3 shows an OFDM baseband receiver comprising four modules. Module 201 includes an A/D converter driver 21, timer 22 and signal conditioner 23; module 202 includes a ~~packet~~ pilot detector 25, frame timer 26, narrowband interference suppression module 24 and first stage receiver 27; module 203 includes a second stage receiver 28; and module 204 includes a decoder 23.

Replace the paragraph beginning at page 18, line 15, with the following.

~~Packet~~ Pilot detector 25 and frame timing block 26 search for the start of a packet. ~~Packet~~ Pilot detector 25 may also provide narrowband interference suppression when the packet is detected. Narrowband interference suppression block 24 applies narrowband interference suppression during the data transport phase of packet reception. In the preferred embodiment this block implements the algorithm of Figure 2B.

Replace the paragraph beginning at page 18, line 24, with the following.

Once the start of a packet has been detected by ~~packet~~ pilot detect block 25 the packet is passed through first stage receiver 27. This receiver may estimate and compensate for frequency and phase errors in the received data. The first stage receiver also includes a Fourier transform operator that transforms the data from time domain data to frequency domain data. The advantage of applying the excision filter to OFDM in the time domain before the receiver FFT is to prevent spectral

leakage from the narrowband interference occurring at all. This greatly simplifies the interference suppression requirements and improves the resulting BER performance.

Replace the paragraph beginning at page 19, line 22, with the following.

At the completion of OFDM ~~packet~~ pilot detection, the receiver returns to its original state, described by step 1 of Figure 2B in which new interferers are searched for prior to the reception of the next in-coming OFDM packet.

Replace the paragraph beginning at page 20, line 4, with the following.

An example of phase lock loop operation from the simulation implementation using a second order digital phase lock loop with loop filter bandwidth set to 1.5 times the OFDM sub-carrier spacing is shown in Figures 4A to 4C. Failure of at least one PLL to achieve lock typically occurred where one interferer was of significantly lower power than the other. For example when one interferer has so low power that it could not be distinguished from background noise. In these cases the low power interferer will have negligible impact on the BER. In Figures 4A to 4C the initial estimates are made using a 64-point DFT. These initial values are shown by heavy solid lines. Figure 4A shows the frequency estimate for a first narrowband interferer as well as the actual interferer frequency. As can be seen the frequency estimate is close to the interferer frequency. In this Figure the interference to noise ratio is 7.5 dB. Figure 4B shows the frequency estimate for a second narrowband interferer. In this Figure the interference to noise ratio is 6.6 dB. As can be seen the frequency estimate is close to the interferer frequency. Figure 4C shows the operation of two phase lock loops, one for each interferer. After the initial estimates subsequent estimate innovations are made using two digital phase ~~locked~~ lock loops initialised to the DFT-based estimates. A PLL 'lock' is said to have been achieved when the lock magnitude is less than 0.5 - the lock values shown in Figure 4C correspond to the estimates shown in Figures 4A and 4B.